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ering is marked: the only obvious change in the engravings made by paleolithic artists is that the incisions have taken on the buff color of the rock and are no longer white as when first made.

In the cavern of Tuc D'Audoubert on the estate of Count de Begouen, near St. Girons, in the Pyrenees, is an even more remarkable example of lack of disintegration. In this cave are the clay models of bison which are in nearly as perfect condition as when made. A clay model is almost a synonym for the ephemeral for the reason that a short exposure to ordinary air causes it to dry and crack, and excessive moisture causes it to collapse. These models of bison are in fact slightly cracked but with this exception are unchanged. It is possible that the cracks were formed within the first few weeks after the figures were modeled and that none has developed in the 18,000 to 30,000 years that have followed. This seems incredible, but the proof of very great age appears to be well established.

The conditions under which the art of paleolithic man has been preserved almost unchanged for thousands of years are to be found in the uniform temperature, lack of sunlight, and absence of circulating ground water. Although the rock in the Altamira cave is saturated there has been slight movement of the ground water and consequently little solution or deposition has been possible. In the cave of Tuc d'Audoubert there is now some solution and the composition of the water which drips from the roof of the cave has changed slightly as is shown in some of the stalagmites which after being built by lime deposited from the water now have crater-like depressions in their summits showing that the water is at present under-saturated. It is probable, however, that the moisture content of the air has remained constant and that, because of this, the clay models have not disintegrated. The remark-

³ Comte de Begouen: "Les Statues d'Argile préhistoriques de la Caverne du Tuc D'Audoubert (Ariège). *Comptes rendus des séances de L'Académie des Inscriptions et Belles Lettres*, 1912, p. 532.

⁴ Macallister, R. S.: "A Text-book of European Archaeology," Vol. 1, 1921, p. 481.

able preservation of the Egyptian wooden models to which reference has been made is due to uniform temperature, lack of sunlight and absence of moisture.

The explanation of such remarkable preservation therefore involves no new principle as it is due to uniform temperature, absence of sunlight, and non-circulation of ground water. These are, indeed, the conditions under which, deep down in the rocks, the skeletons of the vertebrates of the past are preserved.

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THE BEGINNINGS OF AMERICAN GEOLOGY

TO THE EDITOR OF SCIENCE: In his letter, "The Beginnings of American Geology" (SCIENCE, October 27, 1922), Dr. Marcus Benjamin (doubtless quite unintentionally) makes a statement which is not only unsupported by facts but which most unjustly reflects upon the character and career of a distinguished American geologist, a president of the Geological Society of America, and also of the American Association for the Advancement of Science, and, I think, the most unselfish, modest and self-effacing man of science I have ever known.

As in these days whatever appears "in print" is likely to become material for the future historian it seems worth while to correct the erroneous statement.

In his reference to Dr. Newberry's connection with the Geological Survey of Ohio there occurs the phrase "owing to the changes in political administration in Ohio he (Newberry) found himself displaced by a subordinate."

Neither of the two statements incorporated in this sentence is true.

No one who had the good fortune to know Dr. Edward Orton, who was Newberry's successor as director of the survey, will be willing to admit that there is the slightest foundation for what is implied in the last phrase; and those who are familiar with the history of that period of the survey know that Dr. Newberry's failure to continue as its head was not due to a change in political administration in Ohio.

During twelve of the sixteen years covering the entire period in which Dr. Newberry may be supposed to have had any sort of connec-

tion with the survey, governors of the state were of the party which was in power when it was inaugurated through the interest and initiation of President Hayes, himself twice governor during those years.

Nor is there any evidence to show an attitude of personal unfriendliness towards Dr. Newberry or the survey on the part of the two governors belonging to the other political faction, each of whom served one term.

The plain truth seems to be that for the discontinuance of appropriations for the support of the survey under his administration and for the final ending of it by legislative enactment in 1882, Dr. Newberry, himself, was largely if not entirely responsible, though the financial crisis through which the whole country was passing during the early 70's doubtless had much to do with the limitations put upon its operations.

The people of Ohio had been led to believe that the economic and especially the mineral resources of the state would be developed by the survey and it is not surprising that there was impatience when after the lapse of ten or fifteen years nothing of great value on this phase of the work had appeared.

Instead there had been published elaborate reports upon paleontology, involving large expense for beautiful (and valuable) plate illustrations, the cost of which for a single volume being as much as \$34,000.

After three years the legislature modified the organization by creating a geological board consisting of the governor, school commissioner and the state treasurer, which was charged with the general supervision of the survey, though this had, apparently, little effect upon the program of its operations.

Volume 4 of the series of reports was published in 1882, thirteen years after the beginning of the work and was devoted entirely to vertebrate zoology.

In the meantime Dr. Orton, who had been one of Newberry's principal assistants, had been especially interested in the economic and mineral resources of the state, the extent of which was hardly realized at that time, and material for Volume 5 had been gathered. In April 1882 the legislature made an appropriation for the cost of publishing this volume

and at the same time announced that "upon the publication of said Volume 5 the Geological Survey of Ohio is hereby declared to be completed."

It was also provided in the same Act that the publication of this volume should be in charge of a geologist to be appointed by the governor.

The governor, the Hon. Charles Foster, promptly appointed Dr. Orton, who had recently resigned the presidency of the Ohio State University, which he had held from its organization in 1873, in order to devote his entire time to the professorship of geology in that institution.

In 1884 Volume 5 was published, being devoted almost entirely to coal. It has always been the most sought after publication of the survey and the reaction to its appearance was a provision by the legislature "to extend and complete the account of the economic geology of the state that was begun in Volume 5." In 1888 Dr. Orton published a volume on petroleum and natural gas which has been esteemed as equal in value to Volume 5.

The survey became and has continued to be popular with the people of the state and it has ever since been "a going concern." On the death of Dr. Orton in 1899 he was succeeded by his son, Edward Orton, Jr., whose development of the ceramic interests and methods of the state were of nation-wide importance. Desiring to devote most of his time to this special field he resigned in 1906 and was succeeded by the present incumbent, Professor J. A. Bownocker who had served as assistant geologist for several years, and who also fills a chair of geology in the state university.

It is true that the fact of Dr. Newberry's absence during a large part of each year, especially during the winter when the legislature was in session, had a good deal to do with the dissatisfaction which developed a few years after his work began. Although born in Connecticut he was, at the age of two years, brought to Ohio by his parents and the state in which he grew up and was educated always regarded him as one of her illustrious sons.

He was a paleontologist rather than a geologist but if he had been tactful enough to place the emphasis of the earlier years of the survey upon those phases of it in which the people

were vitally interested the story of his connection with it might have been different. As it was Ohio saw adjoining states rapidly developing their mineral resources as the result of geological surveys while her own organization seemed to be producing only beautifully illustrated volumes concerning fossils.

There are enough sins legitimately left at the door of state and national legislatures, in connection with their dealings with science, without adding to their number the failures and mistakes which should really be charged to men of science themselves.

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NOVEMBER 7, 1922

THE COLLOIDAL STATE

EDITOR OF SCIENCE: It seems that one important basis of the anomalous behavior of matter in the colloidal state of subdivision lies in the fact that, in the colloidal zone, increase in dispersion is accompanied by a disproportionately large increase in kinetic activity of the ultramicros, which reaches an extreme at atomic or molecular dispersion. The speed of motion of ultramicros is itself the resultant of several factors (including size, temperature, viscosity of dispersion medium, concentration, free electric fields, etc.), but it probably exercises a very considerable influence in reactions where colloids are involved, *e.g.*, diffusion, adsorption, enzyme action, etc.

For some time I have been accumulating data bearing on this question, and would be pleased to hear from any readers of SCIENCE who know of pertinent experimental facts. Thus Zsigmondy ("Colloids and the Ultramicroscope") has given the size of certain gold ultramicros and their relative amplitudes of motion. Ultramicroscopic examination indicates that gel formation involves aggregation with cessation of visible kinetic activity, and the zone of maximum degree of colloidalness (J. Alexander, *J. Am. Chem. Soc.*, 43, p. 434, 1921) may be that zone where the curve of free surface plotted against particle size, approaches and crosses the curve of kinetic motion plotted against particle size.

An investigation will also be made of the variations in size of ultramicros and ultramicroscopic activity with changes in free acidity (H-ion concentration or p_H value).

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NOTE ON THE FUSARIUM WILT DISEASE OF BANANAS

IN the journal, *Phytopathology*, of September, 1919¹, Dr. E. W. Brandes described in detail his out-door pot inoculation experiment, demonstrating that *Fusarium Cubense*, E. F. Smith is the cause of the very destructive wilt disease of the banana, heretofore generally known as the Panama disease. Since then there has been published in Java a paper by E. Gaumamm on a vascular disease of the banana², in which the author attempts to discredit the work of American investigators of this disease, but particularly that of Dr. Brandes. In a statement by Brandes, of which the writer has a typewritten copy, he reviews Gaumamm's paper and points out various errors and confusion of facts. As the writer, while connected with the United Fruit Company, recently conducted an experiment of exactly the same kind as the one by Brandes above mentioned, it may be important to those interested to briefly describe this experiment and the results. The experiment was made just outside the Company laboratory, in Changuinola, state of Bocas del Toro, Panama. In this case the common Gros Michel banana was employed, instead of the variety Chamaluco employed by Brandes. Otherwise the two experiments were almost perfectly parallel except as to locality.

This experiment was begun November 1, 1921. Twenty-five cement pots were employed, set in corresponding holes in the ground, and

¹ Brandes, E. W., Banana Wilt. *Phytopath.* 9, No. 9, pp. 339-389, pl. 22-34, 1919.

² Gaumamm, E., Over een bacteriele Vatbundelziekte der bananen in Nederlandsch., Indie. Meded. V. H. Instituut V. Plantenziekten, No. 48, Dept. N. Landbouw, Nijverheid en Handel, pp. 135, pl. 8, 1921.